is known to exist, and contrasting the results with those obtained elsewhere with the same instruments.

Prof. Milne mentions Kew and Greenwich as representatives of stations where magnetic and gravitational anomalies do not exist, but, as a matter of fact, Rücker and Thorpe's magnetic survey does show a small magnetic anomaly in the Thames Valley, and certain foreign observers have also inferred a gravitational anomaly.

As to Prof. Milne's special term "gëite" for material in the earth's interior, I must confess that the application of a new word to the unknown material of a problematical core seems to me more likely to hinder than assist. Such special terms constitute an additional obstacle in the way of those who are not specialists. Also existing terms, such as nucleus and core on the one hand, and layer or crust on the other, seem not inadequate, the context showing whether it is the material that is immediately in view.

I have had repeated occasion to deal with elastic problems involving a core and a layer or layers. In fact, the very "earth" for which Prof. Milne expresses a preference, consisting of a layer of about 1/20 of the earth's radius in thickness with a density of average surface rock, and a core of specific gravity approaching 6, is one which I selected some years ago for the purpose of investigating luni-solar tidal action (*Cambridge Phil. Trans.*, vol. xvi. p. 151). Thus I do not speak without experience.

A final point to be remembered is that, according to the investigations of Gauss and others, the earth itself is a magnet of considerable moment. Any theory which claims even provisional acceptance may be expected to give a plausible explanation of this fact, and of the secular change observed in terrestrial magnetism. C. CHREE.

Photograph of Oscillatory Electric Spark.

THE enclosed photograph of an oscillatory electric spark, like most of those which I have taken, differs in some respects, so far as I have seen, from those which have been recorded by other experimenters. It was obtained by the discharge of 22 square feet of coated surface through

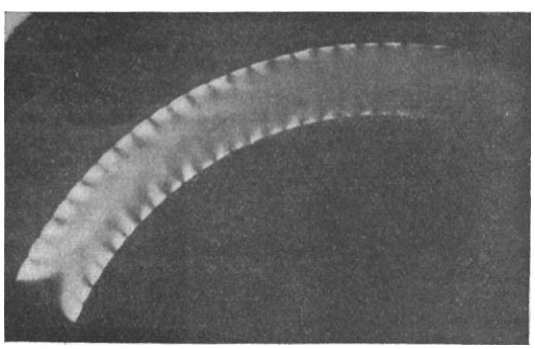

FIG. 1.—Oscillatory electric spark.

¼ mile of coiled wire, the electrodes being of magnesium. The picture was focused on a circular plate fixed on the end of an electric motor, so as to revolve in its own plane. The number of double oscillations was about 3000 per second. C. J. WATSON.

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Our Rainfall in Relation to Brückner's Cycle.

IN the instructive paper on solar and meteorological changes in NATURE (May 7), I observe that Dr. Lockyer suggests 1913 as probably about the centre of the next wet period. A consideration of barometric changes appears to lead to a similar result, and I may be permitted to recall a letter sent you in 1898 (NATURE, December 22, p. 175), in which, discussing with such data the question, "Where do we stand in Brückner's cycle?" I mentioned 1911 as probably near that centre. Such estimates must, of course, be regarded as merely approximate, and open to revision.

This important cycle of Brückner's was lately discussed in a number of letters to the *Times*, and it is satisfactory to see that more adequate attention is now, though tardily, being given it.

Is it not objectionable to treat the British Isles as a whole, since, on Brückner's theory, the western portion shows opposite variation to the eastern?

There is a method of curve-making which seems to be little used by meteorologists, but which is, I think, to be recommended. A series of annual rainfall figures (say) is first translated into a series of plus and minus values (related to the average), and this series is then added algebraically step by step, *e.g.*

$$+9{\cdot}3-1{\cdot}4+0{\cdot}6+0{\cdot}9-1{\cdot}6+1{\cdot}3, \text{ \&c.}$$
$$+7{\cdot}9+8{\cdot}5+9{\cdot}4+7{\cdot}8+9{\cdot}1, \text{ \&c.}$$

This second series is then thrown into curve form. The process is analogous to paying in money to a bank, and drawing money out, and the point reached by the curve at any given time indicates the balance.

Each upward (annual) extension in such a curve represents a wet year, and each downward extension a dry year, and the degree of wetness or dryness is also indicated.

A large comparison of such curves for European and other stations would, I think, throw a good deal of light on the Brückner theory. ALEX. B. MACDOWALL.

The Propagation of Phthisis.

IN a work called "Opera nuova intitulata il Perche, utilissima ad intendere le cagioni de molte cose, &c.," published in Venice in 1520, the following passage occurs:—"Dal sputo del Tisico o da la sua boca viene fuora un vapore fetido e acuto che entra poi per la boca de colui che conversa con quello e corrode simelmente il pulmone de esso e in questo modo genera tisica."

Substitute for *vapore* "material particles," and we have the modern conception of the mode of propagating consumption. This anticipation of modern science seems worthy of note. EDMUND MCCLURE.

TANGANYIKA.[1]

THE title of this work is perhaps somewhat misleading. The reader who expects the book to contain only discussions of speculative questions will be agreeably surprised by finding that the positive contributions made in it to our knowledge of the geology, botany and zoology of Central East Africa are of the most extensive and valuable character. The two expeditions which the author undertook in 1896 and 1899 to Lake Tanganyika and the surrounding districts, following upon the researches of earlier travellers, have thrown a flood of light upon both the geological structure and the fauna and flora of this part of the world, while they have incidentally suggested a number of difficult problems of no small interest alike to the geologist and the biologist.

The surveys of Mr. Moore and of Mr. Malcolm Ferguson, the geologist who accompanied him, have been of value in rectifying and making noteworthy additions to the maps of the area visited. The geographer will find references to a number of new mountain peaks, the heights of many of which are given, with the determination of the heights above sea-level and the depths of many of the lakes, in several of which numerous soundings and dredgings were made.

One of the most valuable results of Mr. Moore's explorations is the confirmation he is able to supply to the conclusions of Mr. Scott Elliot that there exists in East Central Africa a great mountain chain running north and south, and rising at many points, even in this Equatorial region, above the limits of perpetual snow. The height of the snow-line is fixed by Mr.

[1] "The Tanganyika Problem; an Account of the Researches undertaken Concerning the Existence of Marine Animals in Central Africa." By J. E. S. Moore, F.R.G.S., author of "To the Mountains of the Moon." Pp. xxiii + 371; with 7 maps and 140 illustrations. (London: Hurst and Blackett, Ltd., 1903.)

Moore at 13,500 feet, and some of the peaks he thinks may attain a height of 16,500 feet, while Sir Harry Johnston believes that 20,000 feet is a probable minimum of the height of some of them. This great mountain chain, giving rise in some parts of its course to numerous glaciers—the "Mountains of the Moon" of the ancients—Mr. Moore proposes to call "the Great Central African Chain." It extends from the mountains of Abyssinia in the north to the Drakensberg in South Africa, though in some places, as in the neighbourhood of Tanganyika and the Albert Edward Nyanza, it is a broad ridge, the culmination of long eastern and western slopes, rather than a conspicuous chain; so that, viewed from either side, it has little resemblance to a mountain range, even when its summits rise ten or twelve thousand feet above the sea-level.

Mr. Moore discusses the geological structure of this great mountain chain, giving a number of valuable geological sections across it at various points. The origin of the range, he believes, must be assigned to lateral compression, the celebrated "rift-valleys" being regarded by him as subordinate features resulting from the orographic movements in the earth's crust. Although volcanic action has only played a subordinate part in the formation of the great chain itself, in the greater portion of its course, yet in the district lying to the north of Tanganyika, which was carefully explored by our author, we have the still active volcanic district of the Mfumbiro Mountains, a chain of volcanoes running east and west; the highest of these, Karisimbi, is often snow-capped, and has a height of 14,000 feet. Mr. Moore shows that the structure of the great longitudinal valley in which Tanganyika lies has been profoundly modified by the ejection of the materials forming the Mfumbiro chain. The surface of Lake Kivu, to the north of Tanganyika, is 4841 feet above sea-level, while Albert Edward Nyanza, still further north, lies 2000 feet lower, and Tanganyika has a height of 2700 feet. The author points out that previously to the formation of the Mfumbiro volcanic cones, the waters of Lake Kivu must have drained northwards into the Albert Edward Nyanza, and not, as now, into Lake Tanganyika, by the Russisi River. Numerous other volcanic cones occur in the district, generally at the bottom of the rift-valleys. The waters of Lake Kivu contain such a large amount of salts that the pebbles and reeds on the shores become encrusted with a calcareous deposit, which analysis shows to contain 12.66 per cent. of magnesium to 28.65 of calcium. The waters of Lake Kivu, which is sometimes more than 100 fathoms deep, have been analysed and found to contain a very large proportion of magnesium carbonate.

The geological formations met with in the expeditions, the distribution of which in the neighbourhood of the several lakes is shown upon sketch-maps, are as follows, beginning with the oldest:—

(1) Old crystalline rocks—granite, gneisses, schists, quartzite, &c.

(2) Great thickness of unfossiliferous sandstones and shales.

(3) "Drummond's beds," a series of sandstones and shales of about the age of the Trias.

(4) Recent lacustrine strata.

Unfortunately, no satisfactory evidence has yet been adduced as to whether the stratified rocks (2) and (3) can, either or both of them, be regarded as of *marine* origin, and some of the unsolved problems of African geology must await full solution until this determination has been made. At present we have no proof that the stratified masses of the older formation are not, like those of the younger, of lacustrine or fluviatile origin.

Around some of the great Central African lakes there are found extensive alluvial deposits containing the shells of species of Mollusca, which still live in the waters of the adjoining lake. These, with the numerous raised beaches, show that some of the lakes had formerly a much greater extent than at present. It is upon these old alluvial deposits that the celebrated "Park-lands," so well described and so convincingly explained by Mr. Moore, are found. Among the botanical results of the two Tanganyika expeditions, not the least valuable are the investigation of these curious features that have attracted so much attention from all travellers in the district. Mr. Moore shows how the springing up of scattered individuals of the hardy euphorbias has afforded a shade under which plants less able to withstand the burning heat of the sun have grown up and gradually extended outwards. Of course, in the end, these outward spreading patches of vegetation must coalesce and form a tangled forest growth, such as occurs in other parts of Central Africa. Mr. Moore ingeniously argues that the amount of development towards this forest growth may be utilised as a means of determining the geological age of the alluvial flats upon which they are found.

It is on the zoological results of these expeditions, however, that the author of the work before us must be especially congratulated. The addition of nearly 200 species of animals to the fauna of the district is the least important of his achievements, though it shows how assiduous and successful must have been his work as a collector. But Mr. Moore is far more than a collector. By careful observations and experiments carried on during his residence among the lakes, by his studies of living animals in their peculiar environment, and by his work in the laboratory upon the specimens he has brought home, he has made the most substantial additions to zoological science.

On questions of distribution the researches of Mr. Moore have a very important bearing. The discovery by Speke and the missionaries of marine types of mollusca in the waters of Tanganyika, followed as it was by Boehm's discovery of a medusa in the same fresh waters, made it a question of first importance to determine whether the same phenomena were exhibited in any other of the African lakes. To this question Mr. Moore has afforded a complete answer. He has himself examined the faunas of lakes Shirwa, Nyassa, Kela, Tanganyika, Kivu, the Albert Edward Nyanza, the Albert Nyanza, the Victoria Nyanza, and Nivasha. The faunas of four or five more lakes are less perfectly known from the work of other travellers, and it is now certain that the peculiar "halolimnic fauna," as Mr. Moore calls it, is confined to Tanganyika, all the other neighbouring lakes containing only the ordinary types of fresh-water mollusca and fish that occur in similar situations all over the globe. The account given of the distribution of these forms by Mr. Moore, especially in the salt lake of Shirwa, will prove of interest both to zoologists and to geologists.

The fish-fauna of Tanganyika consists of eighty-seven species, of which no less than seventy-four are new to science, and have been described and figured by Mr. Boulenger. The medusa (*Limnocnida tanganyicae*) of Tanganyika has been described from spirit specimens by Mr. Robert Günther, of Oxford; but Mr. Moore has been able, during his residence at the lake, to make drawings of the living animal, to work out its development, and to add much to our knowledge of its habits. We reproduce his drawings of this curious organism, which varies in size from a shilling to a two-shilling piece.

The complete study of the anatomy of the "halolimnic" gasteropods, which so closely resemble marine forms of the Jurassic period, has been carried out by

Mr. Moore and fellow-workers in the Royal College of Science, and a curious form of polyzoan, with some prawns and sponges, have been added to the fauna with marine affinities that have made Tanganyika so interesting to naturalists.

Want of space forbids our entering on a discussion of the theoretical questions dealt with in the work

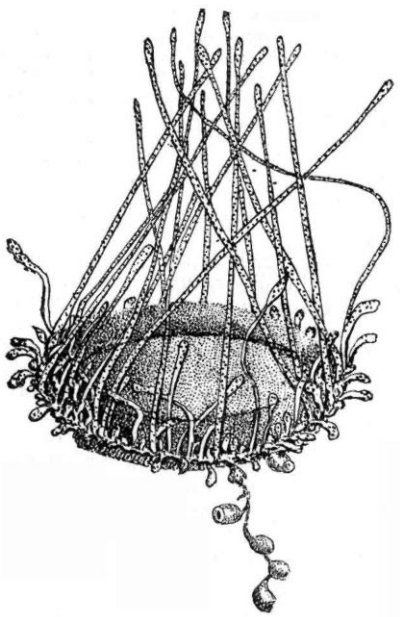

FIG. 1.—Living asexual adult of the Tanganyika medusa, enlarged about one-third. To the right is seen a string of buds becoming detached.

before us. On many of these the last word has not been said, and some of the speculations put forward by the author can be regarded as having only the value of ingenious suggestions. In dealing with so large a mass of new and varied material, the author may have been led in places to express hasty judgments,

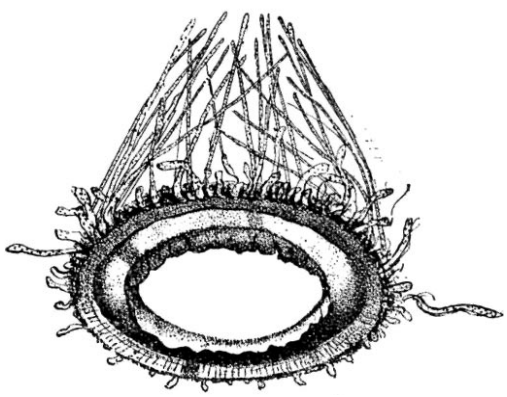

FIG. 2.—Living sexual adult of the Tanganyika medusa, showing the character of the manubrium.

while some of his statements may need qualification or revision; but we are convinced that every naturalist who peruses the work will give him the highest credit for a work of exploration efficiently carried out, and for preparing an account of his researches which is not only satisfactory to the student of science, but is full of interest for the general reader. J. W. J.

ENLARGEMENT OF THE KEW HERBARIUM.

SIR WILLIAM J. HOOKER, the first director of Kew Gardens, as a public establishment, was really the founder of the herbarium at Kew, for before any bequests or gifts were made, his extensive private collection of dried plants and books was, by arrangement with the Government, used for the purposes of the gardens, and accessible to botanists of all countries. When Sir William took up his appointment in 1841, there was neither specimen nor book the property of the garden, and his herbarium and library were first deposited in his own residence at West Park. In 1853 his herbarium and a portion of his library were lodged in the original portion of the present block of buildings, and he received a small annual grant from Government for assistance and maintenance, on the condition that the plants and books were free to other botanists. The same year Miss Bromfield presented the herbarium and library collected by her deceased brother, W. Arnold Bromfield, the author of the "Flora Vectensis," which was edited after his death by Sir Joseph Hooker.

This gift, though not so extensive as some subsequent ones, was very valuable, both in plants and books, the latter including a number of excellent copies of the best editions of many of the early authors, or "old masters." The following year, 1854, Mr. George Bentham presented his very rich herbarium and library to the nation, on the condition that they should be deposited at Kew, and so housed and arranged as to be accessible to himself and other botanists. I may add, parenthetically, that Bentham continued his botanical work at Kew, almost uninterruptedly, for thirty years, the end of which saw the completion of the "Genera Plantarum" of Bentham and Hooker, a work which has not yet been replaced by an equally concise and useful synopsis of a uniform character. Sir William Hooker died in 1865, and in 1866 the Government purchased his herbarium and library, so far as they were not already represented in the national collection at Kew. This purchase included museum specimens, drawings, manuscripts, portraits of botanists, and Sir William's botanical correspondence, covering a period of sixty years. As is well known to the older generations, Sir Joseph Hooker succeeded his father in the directorship, and he in turn was succeeded by his son-in-law, Sir William Thiselton-Dyer, the present director.

Under these successive directors, due greatly to their activity and zeal, the collections of plants and books have continued to increase with great rapidity, partly from increasing Government grants, and partly from private munificence. Among the latter the collections specially deserving mention are:—A. Cunningham's Australasian; Burchell's St. Helena, S. African and S. American; Borrer's British; H. C. Watson's British; Miss Griffith's Algæ; Wight and Rottler's Indian; Boott's Carices; J. Gay's general, presented by Sir Joseph Hooker; Ball's general herbarium and botanical library; Carey's N. American; and quite recently Dr. Alexander Prior's general herbarium, received through Sir Prior Goldney.

All these important gifts consist mainly of named and mounted specimens. Smaller donations number many hundreds. The enormous Indian collections of Hooker and Thomson reached Kew in 1851. They were estimated at 8000 species, and the specimens were so numerous that no less than sixty sets were given away to other botanists and botanical establishments. The distribution of these specimens, and seven wagon-loads of specimens (chiefly of Griffith, Helfer and Falconer's collecting) received from the India House in 1858, was not completed until 1863.

The rapid growth of the herbarium and library neces-